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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Motohiro Itadani, et al.

Serial Number: 10/579,736 Group Art Unit: 2883

Filed: May 18, 2006 Examiner: MOONEY, MICHAEL P

For: LIQUID CRYSTAL DISPLAY DEVICE

DECLARATION UNDER 37 CFR 1.132

Commissioner for Patents
Washington, D. C. 20231

Sir:

The undersigned, Mitsuhito Hirota, declares as follows:

I am a National of Japan, residing at Kawasaki-shi, Japan. I am a Staff Chemist of Precision Optics Lab., Research and Development Center, ZEON CORPORATION which is located at 1-2-1, Yako, Kawasaki-shi, Kanagawa-ken, Japan.

I received a Doctor's degree in pyro-meta in 1994 from Waseda University. In 2003, I joined ZEON CORPORATION and worked on developing liquid apparatus.

I conducted the following supplemental experiment by computer simulation:

1. Object of the Experiment:

The object of the experiment is to obtain omni-directional contrast ratio of liquid display devices having an arrangement of optical elements of the third embodiment of the present specification and having different parameters satisfying the requirements defined in claim 1 of US Serial Application No. 10/579,736 for comparison with the corresponding data for liquid crystal display disclosed in US Pat. No.7,164,458 which is cited in the Office Action dated December 18, 2007.

2. Optical calculation

(1) System for simulation

In Itakura et al., it is disclosed that EZcontrast was used in measuring the viewing angle characteristics of the liquid crystal display. However, the EZcontrast was not available for the undersigned. Accordingly, LCD Master which is a calculation software soled by SHINTECH, Inc. was used. Method of calculation of LCD Master is based on 4×4 matrix method. The 4×4 matrix method is valuable for analyzing propagation of light through media such as liquid crystals or retardation films which exhibit optically anisotropic properties. Conditions for calculation for various optical elements will be set forth in the following.

(2) Conditions of Experiment

i) Liquid cell device

In the Examples disclosed in the present specification, a liquid crystal cell display device of in-plane switching mode having a thickness of 2.74 μm [ZL1-4792 manufactured by Merck Ltd] which has a birefringence Δn of 0.09884 measured at a wave length of 550nm was used to obtain a liquid crystal cell device having a pre-tilt angle of 0°. The liquid crystal cell device has a retardation Re of 275 nm. However, Itakura et al. fail to teach concretely what kind of liquid crystal device was used in their FOURTH EMBODIMENT. Only in column 6, lines 29 to 30, Itakura et al. disclose that the retardation $\Delta n \cdot d$ of the liquid crystal layer 13 used in EXAMPLE 1 OF FIRST EMBODIMENT is 310nm for the liquid crystal. It is not clear if this is applicable for all of the EXAMPLES of Itakura et al. However, of necessity, the undersigned decided to use same liquid crystal cell device ZL1-4792 in Comparative Example 2 of this Supplemental Experiments except that the thickness thereof was changed to 3.14 μm by calculation from the retardation disclosed in Itakura et al. and the birefringence value Δn of 0.09884 as set forth above.

ii) Polarizer

Characteristic value of polarizer in G1029DU in a database of LCD Master was used.

iii) Optical anisotropic member (optical compensator)

The refractive indices in the direction of fast axes of optical anisotropic member in the present specification or optical compensator in Itakura et al. was assumed to be 1.53 and the distribution with respect to wavelength was assumed to be flat.

With respect to the optical anisotropic members of the present invention, optical anisotropic members having different parameters and satisfying the requirement defined in claim 1 prepared in a similar manner as disclosed in Example 1 of the present specification were subjected to a computer simulation to obtain omni-directional contrast ratio.

3. Result

Fig. 10 shows a diagram exhibiting an arrangement of the liquid crystal display device used in Examples 8 to 11 of this Supplemental Experiment and Example 1 of the present specification. In the figure, reference numbers 1 and 5 each represents a polarizing plate, 2 represents a liquid crystal cell, 3 represents optical anisotropic member (A) and 4 represents optical anisotropic member (B), respectively. Table 1 shows parameters and omni-directional contrast ratio of optical anisotropic member (A) and optical anisotropic member (B) in Example 8 to 11 and Example 1 of the present specification. Omni-directional contrasts of the liquid crystal display devices calculated in this experiment by computer simulation are shown in the left-end columns. Parameters of the liquid crystal devices of Examples 8 to 11 of this Supplemental Experiment and Example 1 of the present specification fall within the scope of present claim 1. As seen from Table 1, the omni-directional contrasts of the liquid crystal display devices subjected in Examples 8 to 11 of this Supplemental Experiment and Example 1 of the present specification all show contrast values from >150 (Example 8) to >20 (Example 11). Table 2 shows parameters of the first and second optical compensators and omni-directional contrast ratios of the liquid crystal display of Itakura et al. obtained using the same system as used in obtaining the omni-directional contrasts of the liquid crystal display devices of Examples 8 to 11 of this Supplemental Experiment and Example 1 of the present specification.

Table 1

	Anisotropic Member (A)			Anisotropic Member (B)			OCR [1]
	R_e	R_{th}	Nz[4]	R_e	R_{th}	Nz	
Ex. [2] 1[3]	95	-70	0.24	165	-125	-0.26	>150
Ex. 8	40	-105	-2.1	130	-150	-0.65	>40
Ex. 9	40	-20	0	230	-65	0.22	>85
Ex. 10	210	-105	0	230	-150	-0.15	>20
Ex. 11	210	-20	-0.4	130	-65	0	>25

Notes

[1] OCR: Omni-directional Contrast Ratio

[2] Ex.: Example

[3] Data disclosed in Example 1 of the present specification is reproduced.

[4] Nz: (nx-nz)/(nx-ny) in Itakura et al.

Itakura et al. disclose 1st to 4th embodiments comprising various arrangements of liquid crystal layer, optical compensators and polarizers. Of these, the fourth embodiment has similar arrangement as that of the third embodiment of the present invention as claimed in present claim 1 in that two optical compensators (anisotropic members) are disposed separately between the liquid crystal cell and the polarizer at the incident side and between the liquid crystal cell and the polarizer at the output side. Fig. 11 is a reproduced diagram

exhibiting an arrangement of the liquid crystal display disclosed in EXAMPLE 1 OF FOURTH EMBODIMEBNT of Itakura et al. (c.f.: FIG.21B of Itakura et al.) In Fig. 11, reference numbers 31 and 32 each represents a polarizing plate, 13 represents a liquid crystal layer, 71 represents a first optical compensator and 72 represents a second optical compensator, respectively. It is noted that the arrow lines in optical compensators in Itakura et al. show the direction of the refractive index nx, but this direction is not necessarily the same as the direction of the in-plane slow axis of the optical compensators. In fact, when nx-ny<0 as it is in OC-2 as shown in Table 2, the in-plane slow axis of the compensator 72 in Fig. 11 is perpendicular to the direction of the direction of the refractive index nx, namely, the direction of the arrow line. However, FIG.21B of Itakura et al. was reproduced in Fig. 11 as it is disclosed in Itakura et al.

Properties of 1st and 2nd compensators and omni-directional contrast ratio of the liquid crystal display of EXAMPLE 1 OF THIRD EMBODIMEBNT of Itakura et al. is summarized as Comparative Example 2. The omni-directional contrast ratio for Comparative Example 2 was found to be >10.

Table 2

	OC-1[1]			OC-2			OCR[3]
	R_e	R_{th}	Nz	R_e	R_{th}	Nz	
CEX2[2]	412	113	0.774	-320	-160	1.00	>10

Notes

[1] OC: Optical compensator

[2] CEX: Comparative Example in this experiment

[3] OCR: Omni-directional Contrast Ratio

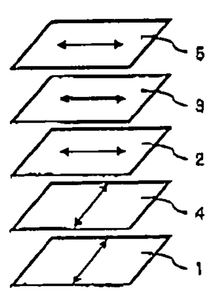

Fig. 10

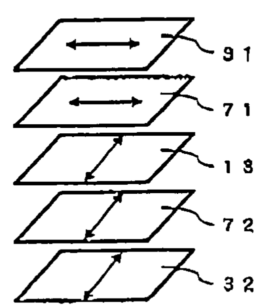

Fig. 11

4. Discussion

By comparing the omni-directional contrast ratio of the optical display devices of Examples of this Supplemental Experiment and Example 1 of the

present specification shown in Table 1 which correspond to the liquid crystal apparatus claimed in present claim 1 of the present invention with that of Comparative Example 2 shown in Table 2 which were obtained for liquid crystal display of Itakura et al. having a similar structure as the liquid crystal apparatus as claimed in present claim 1 except the difference in parameters and the direction of in-plane slow axis of the second optical compensator, it is obvious that the liquid crystal display device of the present invention exhibits superior contrast over Itakura et al.

5. Conclusion

It was confirmed that the omni-directional contrast of the liquid crystal display apparatus of presently claimed invention has advantage over that of the liquid crystal display of Itakura et al.

The undersigned declares that all statements made herein of his knowledge are true and all statements made on information and belief are believed to be true: and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that willful false statements may jeopardize the validity at the application or any patent issued thereon.

Signed this 13 th day of March, 2008

Mitsuhito Hirota

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